BIOENERGY TECHNOLOGIES OFFICE

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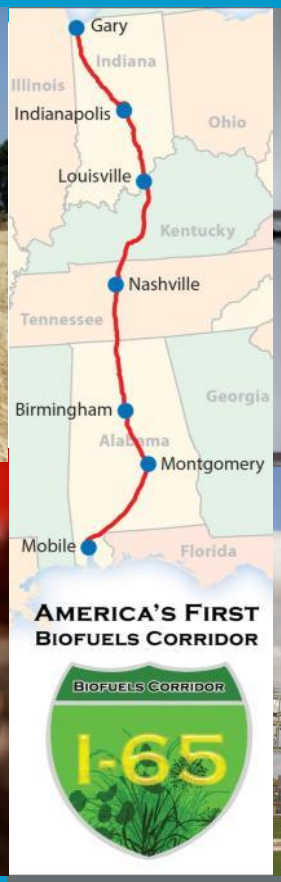
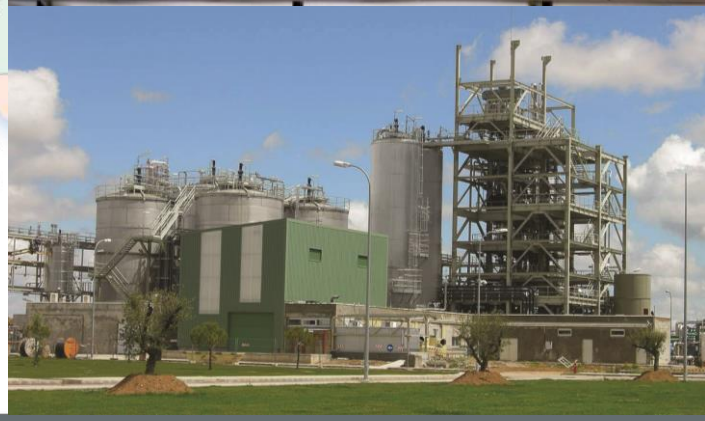




Biomass R&D Technical Advisory Committee

November 21, 2013

Jonathan Male

Director,

Bioenergy Technologies Office

Assistant Secretary David Danielson's Five Questions

- **HIGH IMPACT:** Is this a high impact problem?
- **ADDITIONALITY:** Will the EERE funding make a large difference relative to what the private sector (or other funding entities) is already doing?
- **OPENNESS:** Have we made sure to focus on the broad problem we are trying to solve and be open to new ideas, new approaches, and new performers?
- **ENDURING U.S. ECONOMIC BENEFIT:** How will this EERE funding result in enduring economic benefit to the United States?
- **PROPER ROLE FOR GOVERNMENT:** Why is what we are doing a proper high impact role of government versus something best left to the private sector to address on its own?

INNOVATION

-- Innovation is central to each question.

Innovation versus Invention

- Innovation is the improvement of a product or process (often in combination) which creates meaningful social/economic impact

  "The successful translation of 'new ideas into tangible societal impact.''

  - USC Stevens Institute for Innovation

- Innovation often involves:
  - Significant advances along an entire value chain
  - Market demand and public acceptance
  - Correct timing – confluence of historical factors/trends
  - Cross-cutting, interdisciplinary inputs
  - Longer term and significant impacts on economics and culture

- Invention is merely the starting point for innovation

Innovation in the Bioenergy Technologies Office

Innovation is one of EERE's distinct value propositions:

- BETO has the unique role of supporting the entire value chain and driving the innovations that will have meaningful national impact over the medium/long term

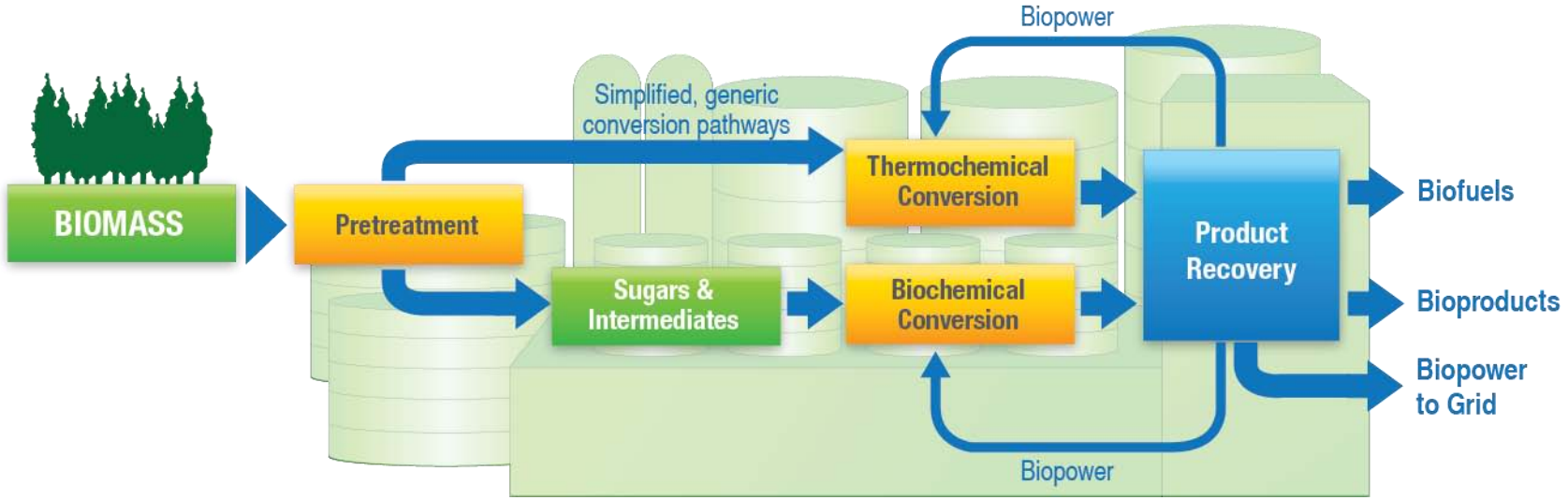
Initial Needs for the Bioenergy Technologies Office:

- Expanded understanding of the supply chain:
  - Interactions with refiners and the petroleum industry
  - Interactions with OEMs and vehicle infrastructure
- Innovation Metrics:
  - Impacts/job creation across office's history: IBRs, Sun Grant, Consortia, Labs, etc.
  - Other methodologies to identify and track progress are needed
- Messaging:
  - Better ways to communicate progress on multiple fronts, not just the "ribbon-cutting" events

Innovation is Challenging and Involves Risks

De-risking of technologies is central to R&D into and through the D&D role, addressing greater integration and scale:

- Technical, construction, operational and financial/market risks
- DOE needs new ways to communicate technical risk



Biomass Key Challenges	Pretreatment Key Challenges	Conversion Key Challenges	Product Key Challenges
• Reliable supply • Consistent quality • Affordable delivery	• Biomass feeding • Biomass sizing and moisture • Solids handling	• Products yields • Construction materials • Catalysts • Fermentation organisms	• Separations • Catalytic upgrading • Recycle loops

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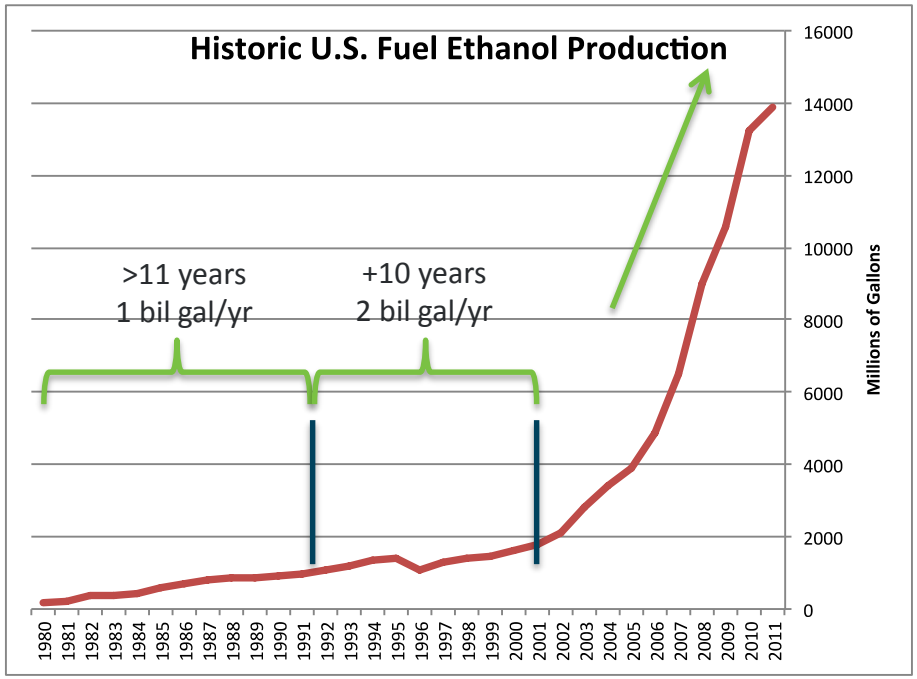
Multi-Decade Endeavor

Corn Ethanol

Did not get here overnight



- >11 years to reach 1 billion gallons/year
- +10 years to exceed 2 billion gallons/year
- Latest decade
  - From 2 billion gallons/year to nearly 14 billion gallons/year

Innovation takes longer than expected

Source: Renewable Fuels Association: http://ethanolrfa.org/pages/statistics

BETO 2013 Peer Review

May 20-24, 2013
Hilton Mark Center, Alexandria, VA

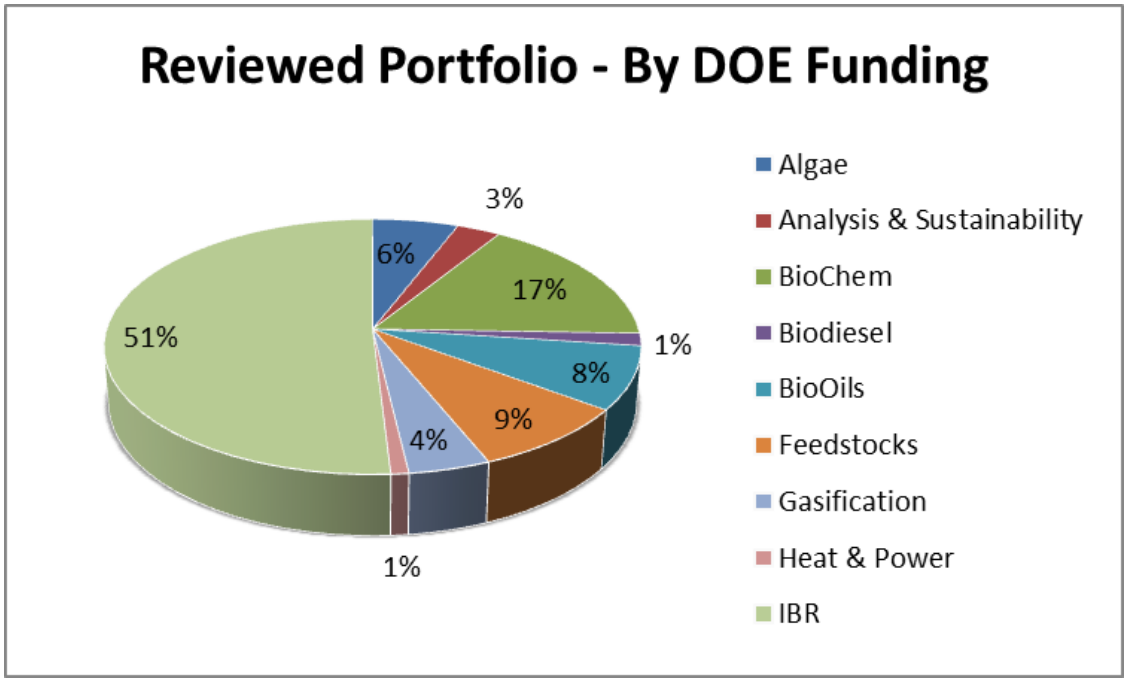
- 4 day event, 7 breakout rooms, 450 attendees

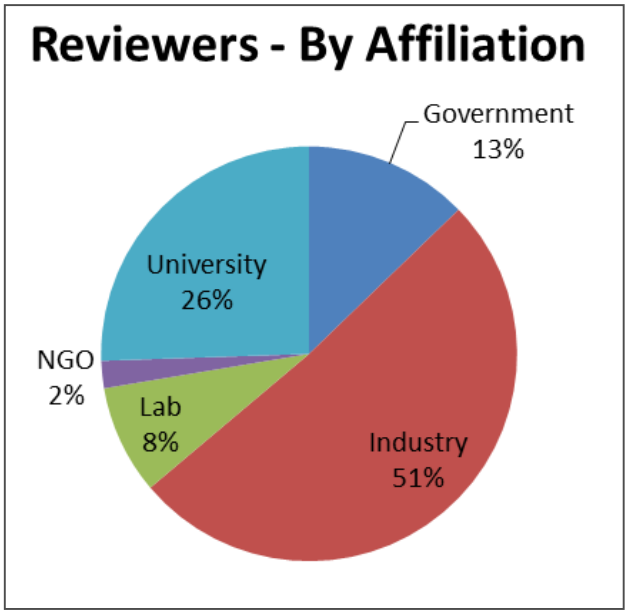
July 30, 2013
Renaissance Hotel Washington, DC

- 1 day event, 1 general session, 150 attendees

2013 BETO Peer Review Background

- 219 projects were reviewed across 9 technology areas, representing a DOE portfolio investment of $1.6B over the lifetime of the projects (~86% of the BETO portfolio)
- 42 independent expert reviewers from industry, academia, and other government agencies
- Results of the Peer Review inform strategic planning, budget formulation, upcoming FOA development, and other budget and funding decisions





Z Score Analysis

Statistical Analysis of Results

- Z scores were used to normalize results and compare individual projects and categories of projects across technology areas

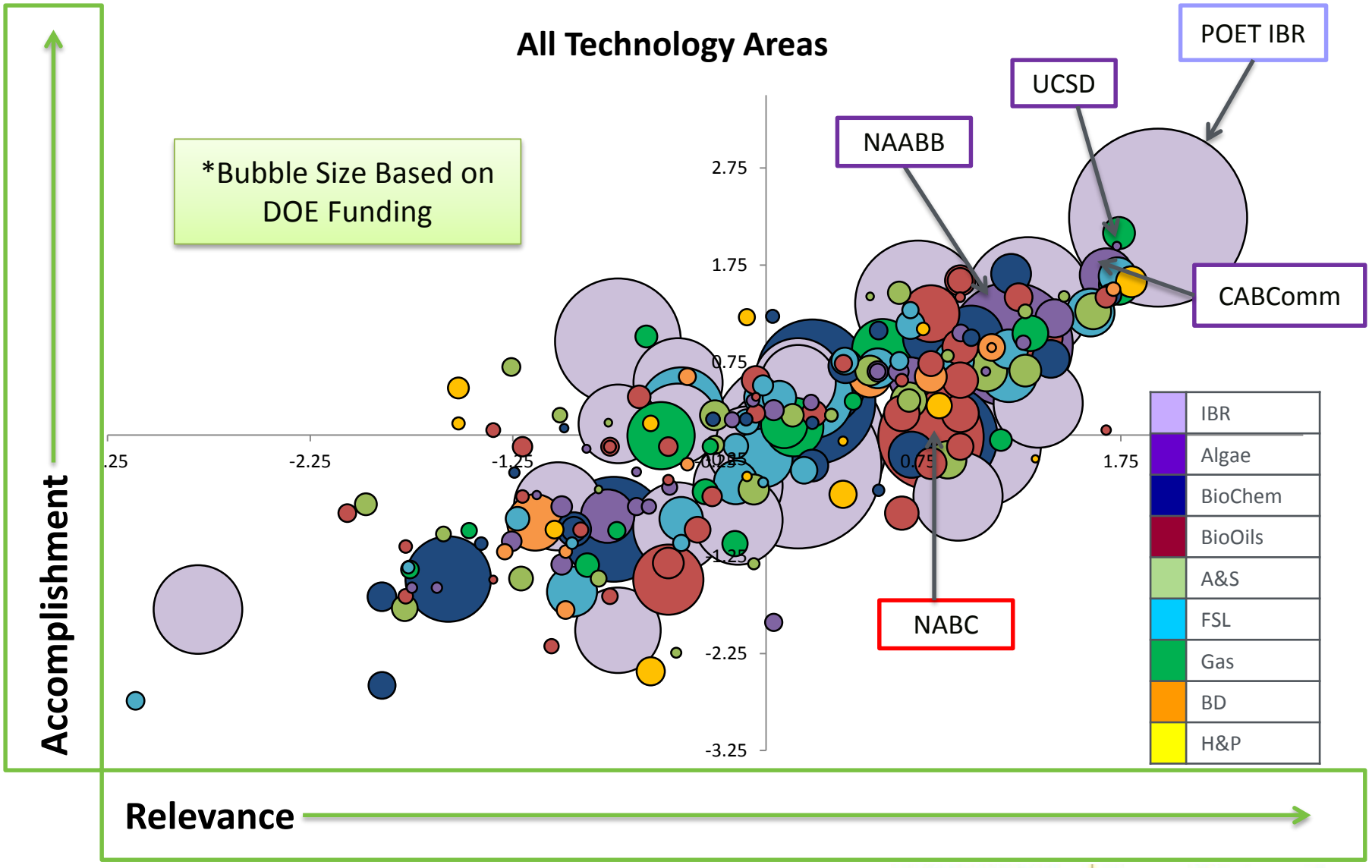
Z score = [(weighted average project score) – (technology area average score)] / (standard deviation of the technology area)

$$z = \frac{x - \mu}{\sigma}$$

  - Z scores were calculated for overall weighted score, and for each criteria on which projects were evaluated
  - Analysis eliminates bias within the review panel by comparing each project only to other projects within their technology area
  - Charts depicting Z scores by Category and Award Type compare average Z Scores for all the projects within each category or award type

- No definitive conclusions
- Results are often only a starting point for discussion, but can inform BETO/EERE decision making
- Project funding, lifespan, categories based on self-reported PI information

Z-Scores for All Projects



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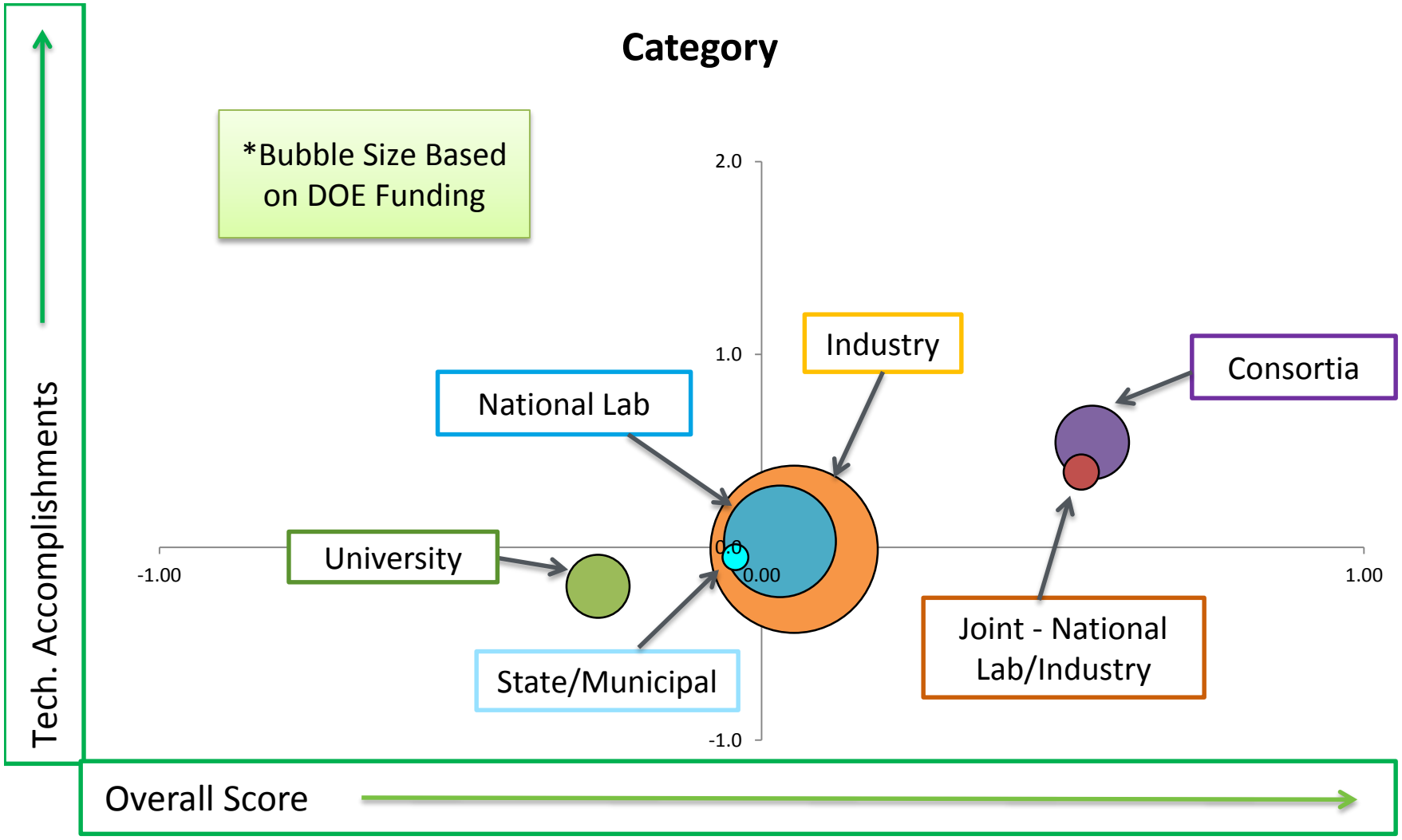
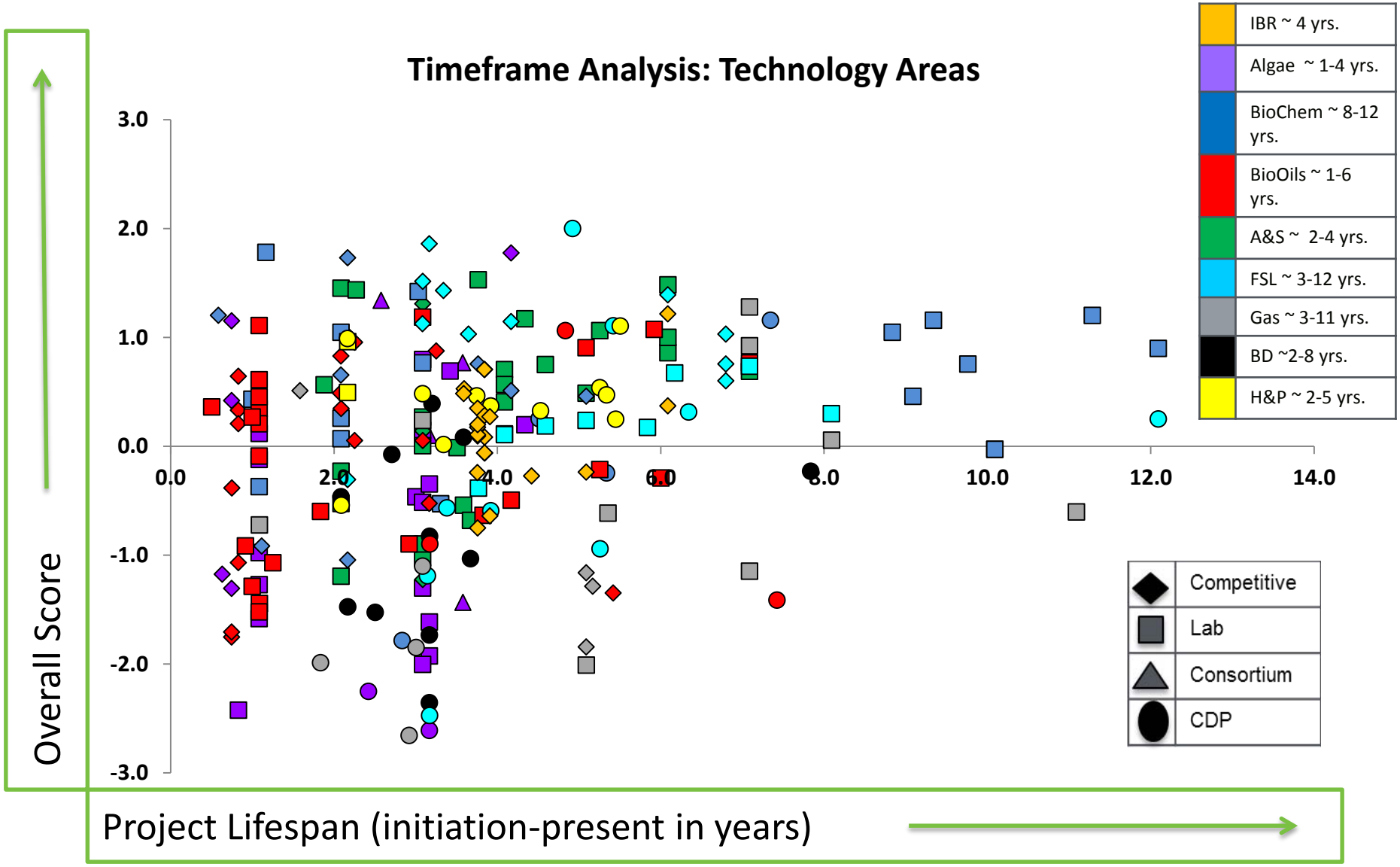
Average Z Score by Category Type (based on PI affiliation and project abstract)

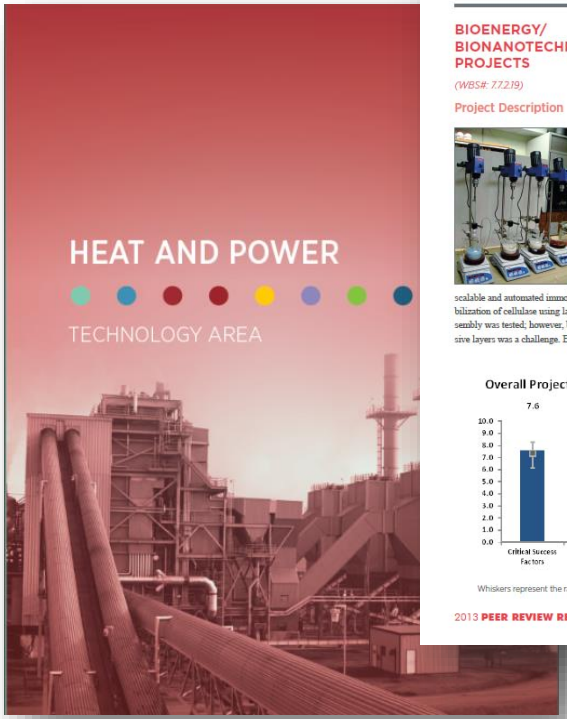


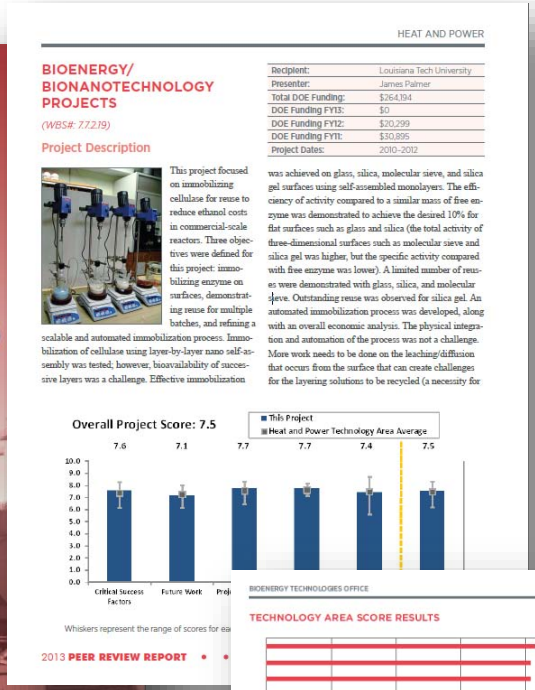
Project Z-Scores Relative to Lifespan (from Quad Chart)



Peer Review Final Report

- All report content is complete
- Report is being finalized and prepared for publication - targeted for December
- 2-pager streamlined project format; around 700 pages when complete





Steering Committee Feedback

Overall Recommendations from the Steering Committee

- External Steering Committee participated in the entire Peer Review process, including the Project Peer Review, and the Program Management Review
- The Steering Committee provided planning guidance, reviewer recommendations, and other inputs throughout the process and drafted the Steering Committee Final Report detailing overall feedback, strengths and weaknesses, gaps, and overall recommendations for the Office

- George Parks served as the de-facto Steering Committee Chairmen and will now provide the perspective of the Steering Committee. George is the President of FuelScience, LLC, and previously spent over 30 years at ConocoPhillips

BETO Response

BETO Response - New Initiatives

Renewable Carbon Fiber

- Bioproducts to enable biofuels
- DOE is working to produce innovative new materials from biomass, by utilizing sugars, lignin, and other biorefinery products, to enhance industry economics

Incubator Program

- Filling the onramp to the BETO Road Map with emerging ideas
- DOE is creating a dedicated, annual funding mechanism to support innovative technologies that are not represented in DOE's existing technology portfolio

Natural Gas-Biomass to Liquids

- DOE is exploring opportunities to combine biomass with low-cost natural gas for the production of liquid fuels
- Zia Haq will be providing the TAC with more information on the outcomes of our recent Natural Gas-Biomass to Liquids (GBTL) Workshop tomorrow at 10:00 AM

BETO Response – Continued

- Addressing project overlap – new Annual Operating Plans (AOP) where all AOPs are shared throughout BETO and the labs
- Continued efforts on techno-economic analysis (TEA) and refinement of common assumptions, ex. the algae harmonization team and the technology pathways assessment team
- To accelerate synergies with petroleum refineries, a refinery infrastructure expert advisory group was established for analysis projects
- Funding for large projects – BETO currently has an open RFI (closing December 6th) to capture stakeholder comments and help refine a potential FY15 D&D FOA
- Currently developing best management practices for deployment – which will be disseminated through conferences and publications

Back Up

Industry and Government Challenges

- Energy projects have multi-decade time horizons, requiring lower risk

Risks Include[1]	Mitigation and Continuing Challenges
Technology	Validation can be done at pilot scale
Construction	Demo scale projects can get EPC construction and performance guarantees
Operations	Pilot and Demo scale performance can validate operations
Finance	Competitive awards, Loan guarantees, IPOs, Debt finance, all are needed
Feedstock Supply	Pioneer plants develop harvest and logistics operations at scale
Product Off take	Long term purchase agreements extremely rare

- Significant risk creates a government role for applied research, pilot, demo, and pioneer "first of a kind"

1 – Koonin S, Gopstein A, *Accelerating the Pace of Energy Change*, Issues in Science and Technology, Dec 2010